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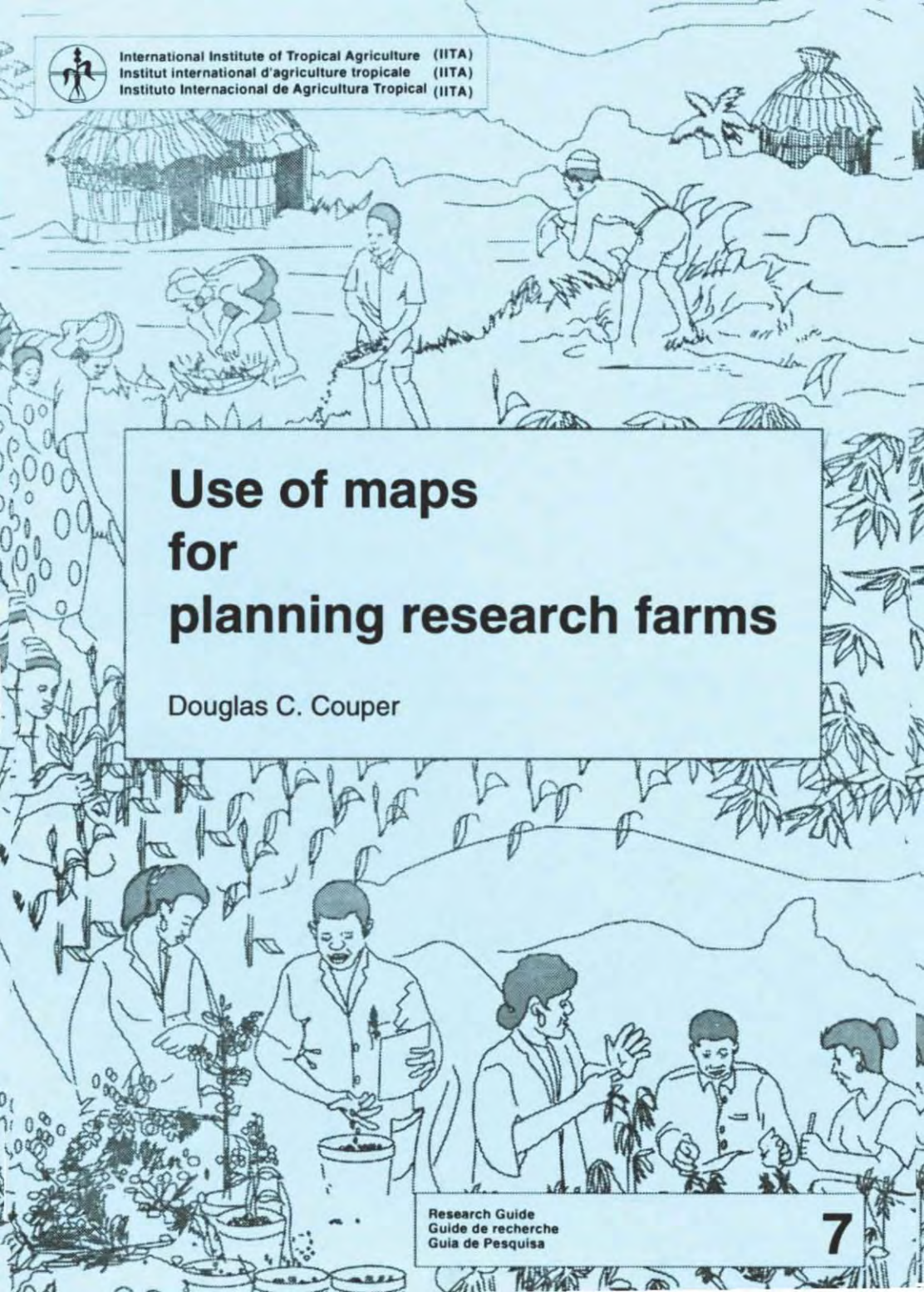

Use of maps for planning research farms

Douglas C. Couper

Research Guide
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7

IITA Research Guide 7

Use of maps for planning research farms

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IITA Research Guides

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Use of maps for planning research farms

Objectives. This guide is intended to enable you to:

- explain topographic maps,
- determine slopes,
- plan land use,
- interpret land capability maps,
- plan farms.

Study materials

- Topographic maps.
- Land capability maps.

Practicals

- Interprete different types of maps.
- Determine slopes and land form from map readings.
- Practice planning of land use.
- Practice farm planning: draw farm plans based on topographic and soil maps.

Questions

1 What indications should a true map include?
2 What is the main type of maps used by farm managers?
3 What are contour lines?
4 What is a "contour interval"?
5 How do you convert map distance into real distance?
6 How do you determine slopes?
7 On a map scale of 1 : 2 000, how much is 1 cm in reality?
8 What slopes are inadvisable to cultivate?
9 How can you use areas that are too steep for cropping?
10 How can you identify natural drainage ways?
11 Where would you site access roads?
12 For what purposes can you use topo-maps?
13 Where would you locate water storage tanks and buildings?
14 What are suitable sites for dams?
15 What information do land capability maps contain?
16 How can you classify soils into positional features?
17 How can you rank soils into classes?
18 What is probably the most suitable soil classification for agriculturists?

Use of maps for planning research farms

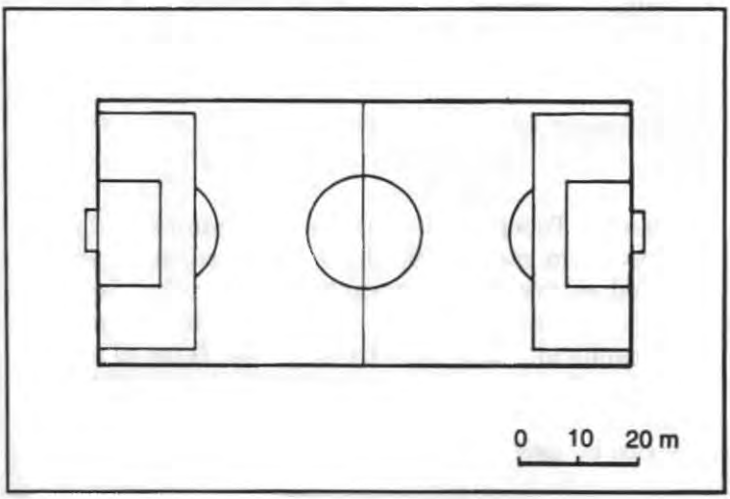
Abstract. Topographic maps is the main type of maps used by farm managers. In agriculture, surveying is required to prepare topographical maps that indicate variations in the level of the land's surface. Topographical maps are the basis for farm planning. They can be used for determining slopes and land form. In combination with information on soil types, they can be used for farm planning.

1 Topographic maps

Many types of maps can be used for different purposes, such as an easy to recognize map (Figure 1) for the soccer player, road maps for the traveller (Figure 2), and pictorial maps for illustrative purposes (Figure 3).

A true map is a drawing of an area which shows all items and distances in proportion to each other, that is, they are drawn to a set scale. Symbols may be used on a map to indicate different features such as buildings, marshes, rocks, trees, roads, railways etc. A map may also be oriented to surrounding areas by indicating its relation to North. A true map must therefore include an indication of scale, an "Arrow" for "true" or "magnetic" North, and normally a legend.

Figure 1. Easy to recognize map.



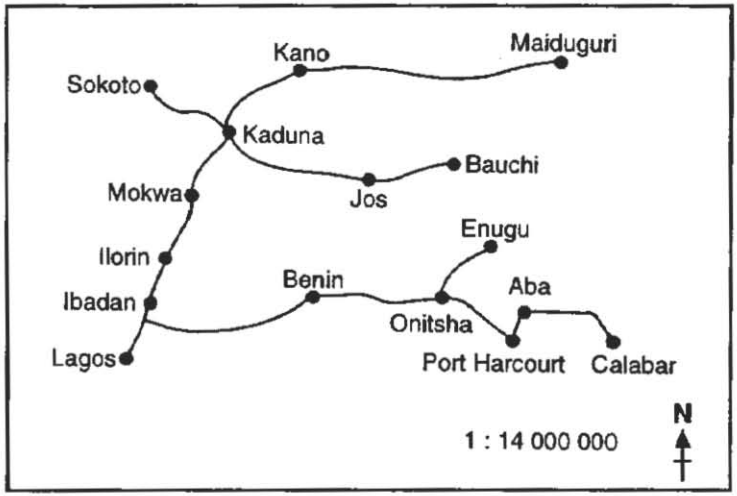
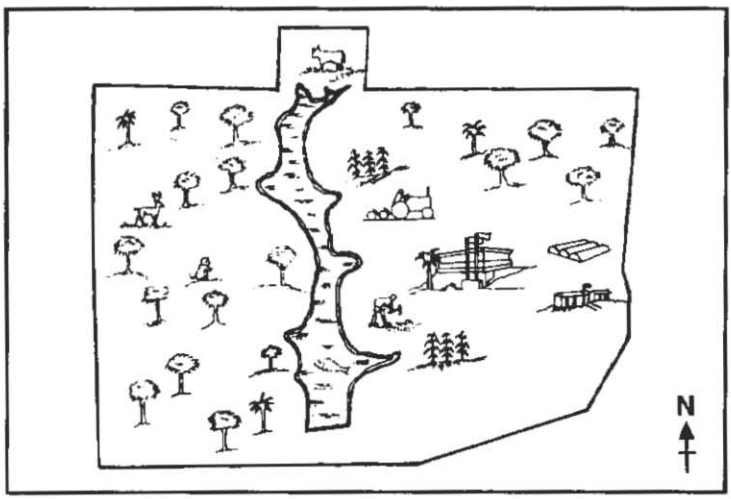


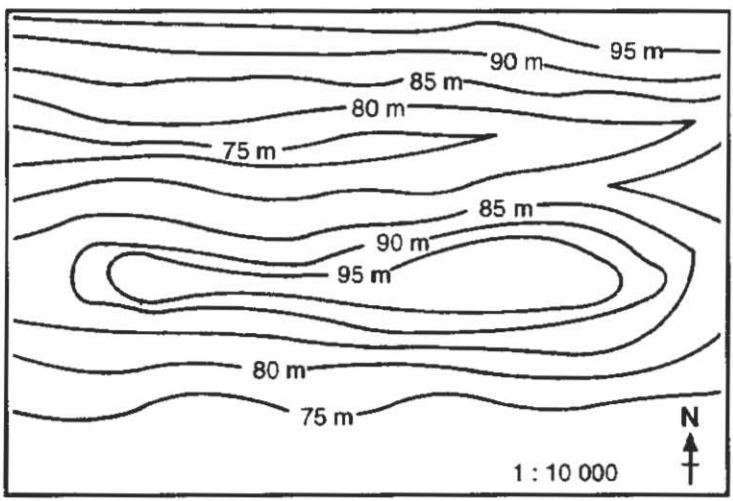
Figure 2. Road map.

Figure 3. Pictorial map.



The main type of map which is used by farm managers is called a topographic map, or "topo-map" (Figure 4). A topo-map shows variations in land level as indicated by contour lines. A contour line connects up all points of a given height above sea level, or above another set level, on the map. Each contour line represents a height. The height is always written on the contour line.

Figure 4. Topographic map.



2 Determination of slopes

Contour lines are lines drawn on a map joining points with equal elevation above (or below) sea level. The difference in height between two consecutive contour lines is known as the contour interval.

Slopes can be determined by measuring the distance between contour lines on a topo-map. Map distance is converted into real distance by multiplying by the scale factor.

This real distance is then compared to the difference in height of the two contour lines bounding the slope to be determined (not necessarily two consecutive contour lines), and expressed as a percentage. See example 1.

It is probably safer and more accurate to measure the distance over several contour lines. See Example 2.

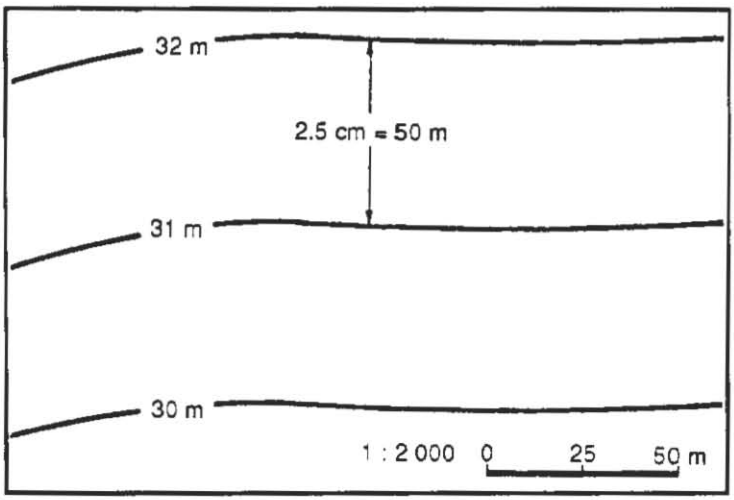
In most areas of tropical Africa, it is inadvisable to cultivate slopes in excess of 7 %. With an accurate topo-map, one can determine which areas are safe or unsafe for cropping.

Areas which are too steep for cropping may be used for trees, pasture, or left under natural cover. Designate areas considered topographically suitable for cropping, as agricultural blocks, for example, block A, block B, etc. Examine the topography of each block to plan its development.

Example 1 (Figure 5):

Map distance between two contour lines	2.5 cm		
Scale	1 : 2 000 (1 cm	=	20 m)
Real distance between contour lines	2.5 x 20	=	50 m
Vertical difference	32 m - 31 m	=	1 m
Slope	1 m in 50 m or 2 m in 100 m	=	2 %

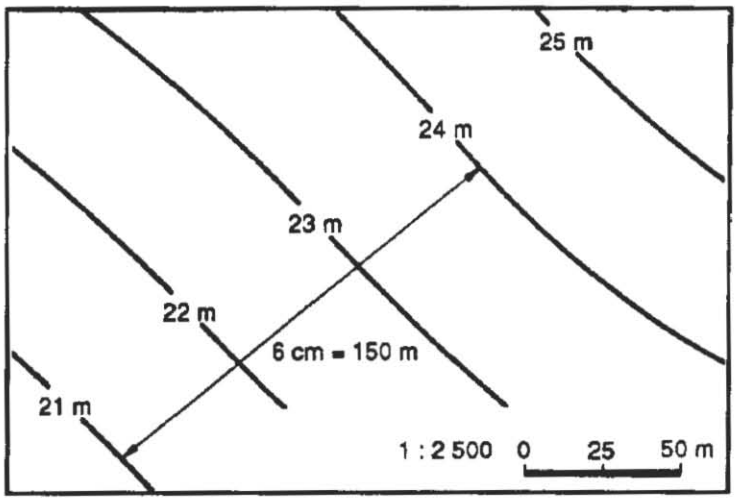
Figure 5. Calculating slope (two consecutive contour lines).



Example 2 (Figure 6):

Map distance between 21 and 24 m contour lines	6 cm		
Scale	1 : 2 500 (1 cm	=	25 m)
Real distance between 21 m and 24 m contour lines	6 x 25	=	150 m
Vertical difference	24 m - 21 m	=	3 m
Slope	3 m in 150 m or 2 m in 100 m	=	2 %

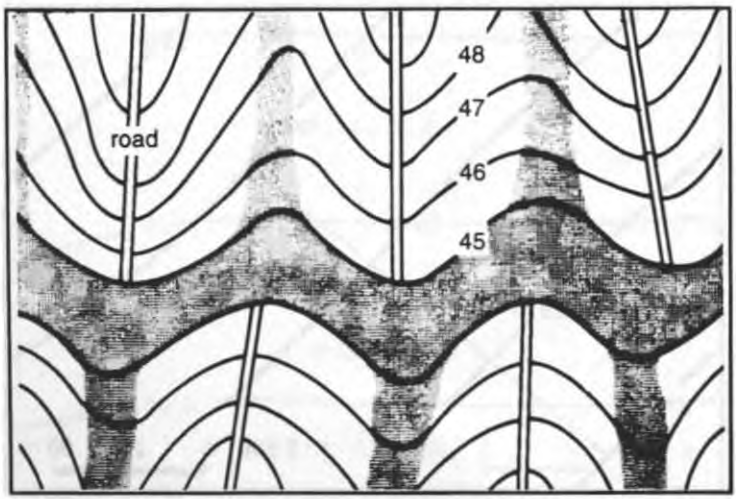
Figure 6. Calculating slope (more than two contour lines).



Determine the land form of each block from the topo-map to identify natural drainage ways. Use these natural drainage ways as waterways when preparing a soil conservation plan (Figure 7).

Between two natural drainage ways, two slopes usually rise to form a crest. Consider siting access roads along these crests and afterwards, fit the soil conservation measures into the block as previously described.

Figure 7. Natural waterways (shaded) and roads.



3 Planning land use

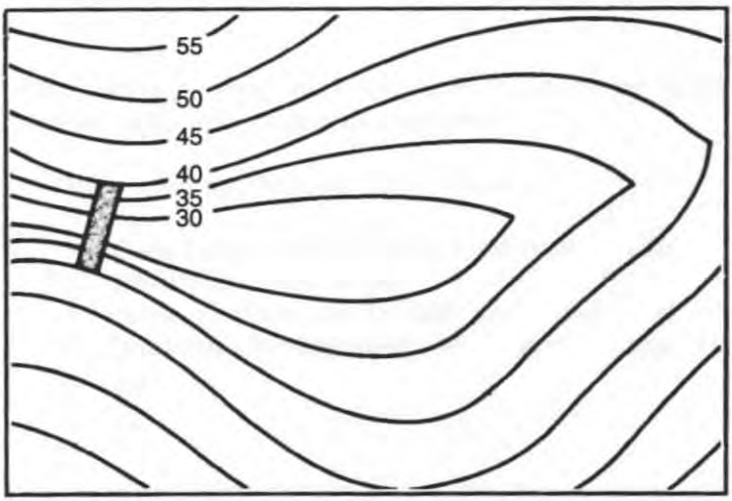
Make full use of topo-maps when planning land use. Topo-maps can be used to:

- identify high areas. Use high areas as locations for water storage tanks or for building sites. Visualize the view from a given point on a topo-map to decide its suitability for housing. For example, does a house have a pleasant view?

- decide on suitable sites for dams. Examine contour lines of valleys. Where a valley obviously narrows and has steep slopes is a suitable site for a dam (Figure 8).

- calculate the size of a lake. The area and volume of the lake resulting from the dam can also be calculated from the contour lines.

Figure 8. Dam site.



- estimate earth fill for roads. Calculate the length and volume of earth fill for road-carrying embankments from the map. This data is useful in estimating machinery needs or in preparing tender documents.

- determine drainage of proposed building sites. Before planning buildings, calculate the amount of cut and fill required on steeply sloping land as this can be a considerable cost.

- plan irrigation schemes. Estimate the amount of cut and fill needed for land levelling, and the height of water lift required to know the correct pump sizes and pipe diameters.

4 Land capability maps

Land capability maps contain information about soil types as well as topography. Soil and topography determine how land may be utilized.

Soil scientists classify soils in different ways. Soil classification maps need to be interpreted for use by agriculturalists. Always insist that the soil surveyor presents soils information in a manner which is understandable to a non-soil scientist.

Soils may be classified into positional features such as (Figure 9):

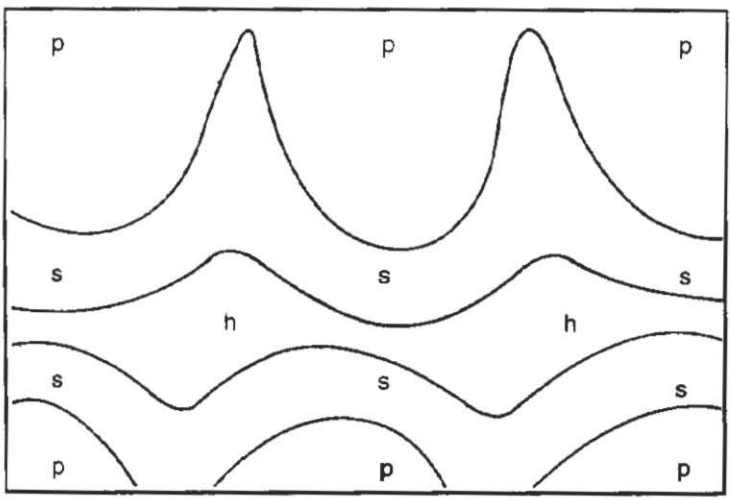
- Plateau land. Level land, generally useful for agriculture.
- Sloping land. Useful for agricultural purposes if slope is not too severe.
- Valley bottom land. Permanent swamp (hydromorphic), flooded during the rains, alluvial soil, or small stream or river in basement complex soil.

Alternatively, soils may be ranked into 3 or more classes, with sub-classes as required:

- Very good agricultural land (Class I):
    - deep loamy soil and level land (suitable for cereals and root crops);
    - more shallow sandy soil and level land (suitable for legumes, soya, groundnuts, etc).

- Marginally good agricultural land (Class 2):
  - good soil but steep slopes (suitable for tree crops);
  - shallow soils and steep slopes (suitable for pasture);
  - poorer soils but level land (suitable for pasture).

Figure 9. Land types: p - plateau, s - slope, h - hydromorphic valley.



- Poor agricultural land (Class 3):

    - poorly drained hydromorphic soil (may be suitable for rice);
    - steep slopes and poor soil (leave under natural cover);
    - lateritic or rock outcrops (use for building and road fill);
    - poor soil, level/high areas (use as building sites).

Other maps use soil classifications common in a given area. For example, the IITA Ibadan farm map carries 14 different soil series with local Nigerian names such as "Iwo", "Apomu", "Gambari" etc. Most agriculturalists in Nigeria have some idea of the agricultural capability of these different soil types.

The most suitable soil classification for agriculturalists is probably the Soil fertility and capability classification (SFCC) (Table 1).

Location	Taxonomic classification	Parent material	SFCC Textural type	SFCC Condition modifier
Onne Port Harcourt Nigeria	Typic Paleudult (Uyo Series)	Coastal sandy sediments	SL	e k h a
Siakgo Embu Kenya	Eutrustox	Volcanic materials	CC	i d
Kindaruma Embu Kenya	Tropeptic Haplustox	Vicaceous gneiss weathered *in situ*	CC	i d

Table 1. Soil fertility and capability classification (SFCC).

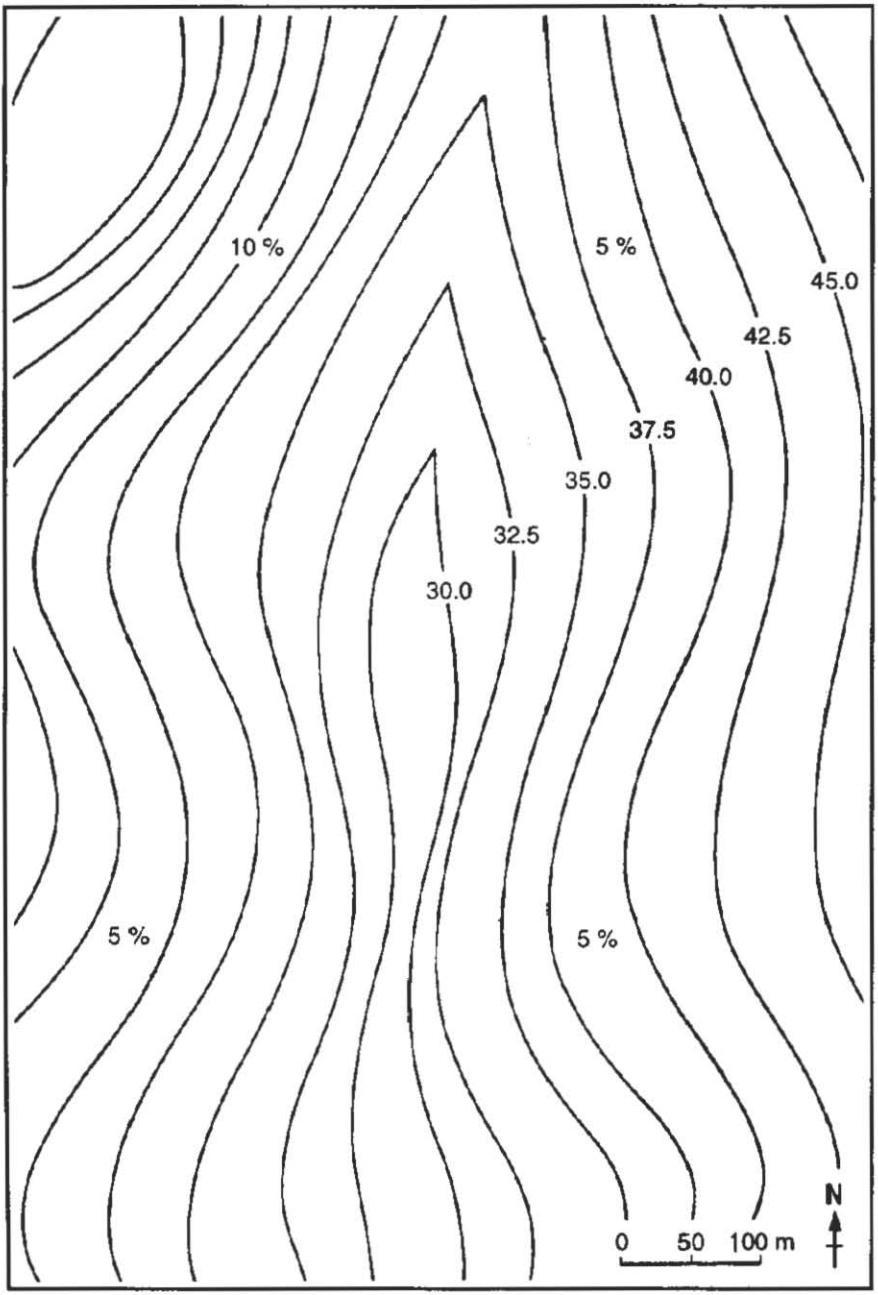
Textural types:
- S = sandy
- L = loamy
- C = clayey
- R = rock or other hard root-restricting layer

Condition modifiers: (examples)
- e = low cation exchange capacity
- h = acid
- k = potassium deficiency
- a = aluminium toxicity
- i = high P fixation by iron
- d = dry

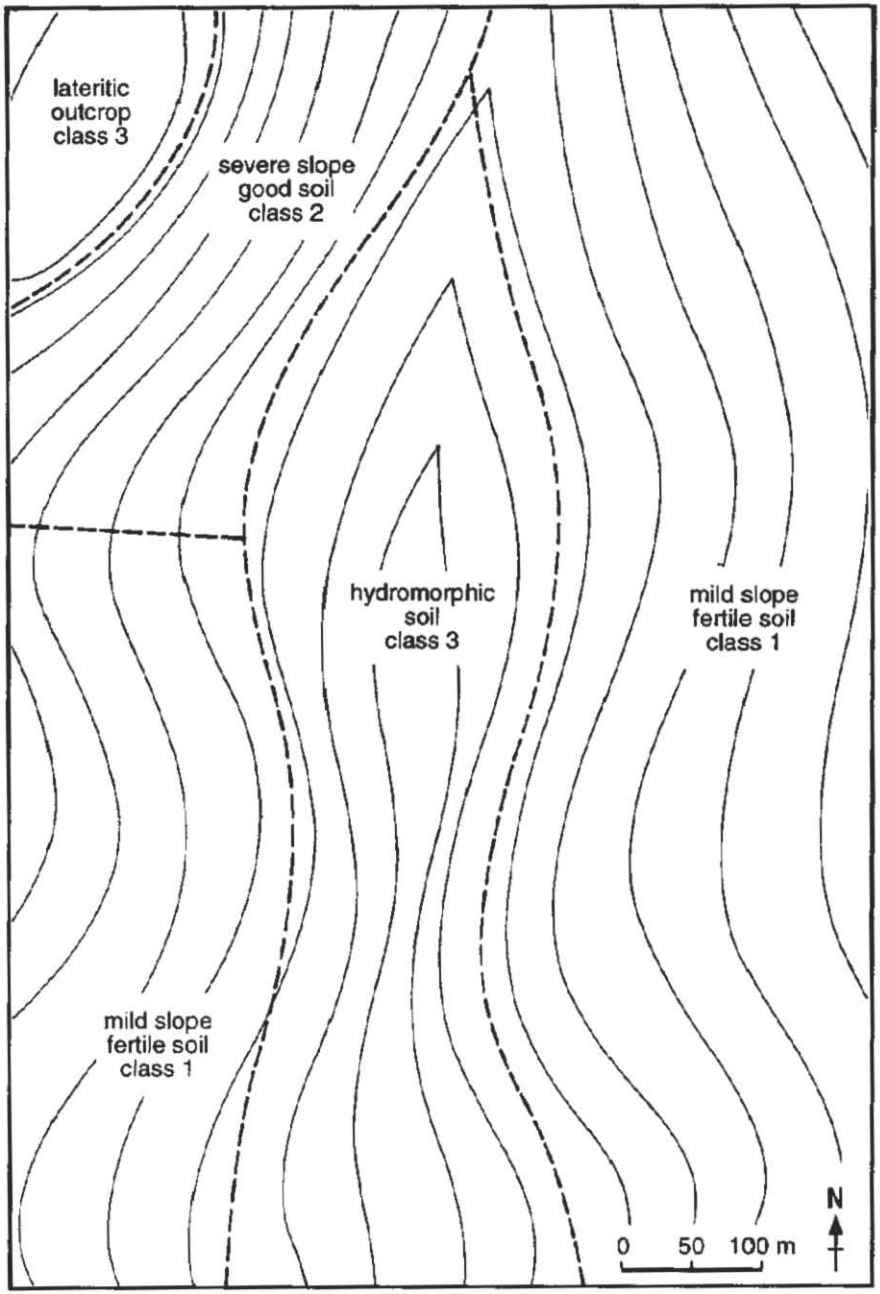
5 Land planning exercise

The following series of maps indicate possible stages of land planning, based on the land forms shown on Map 1:

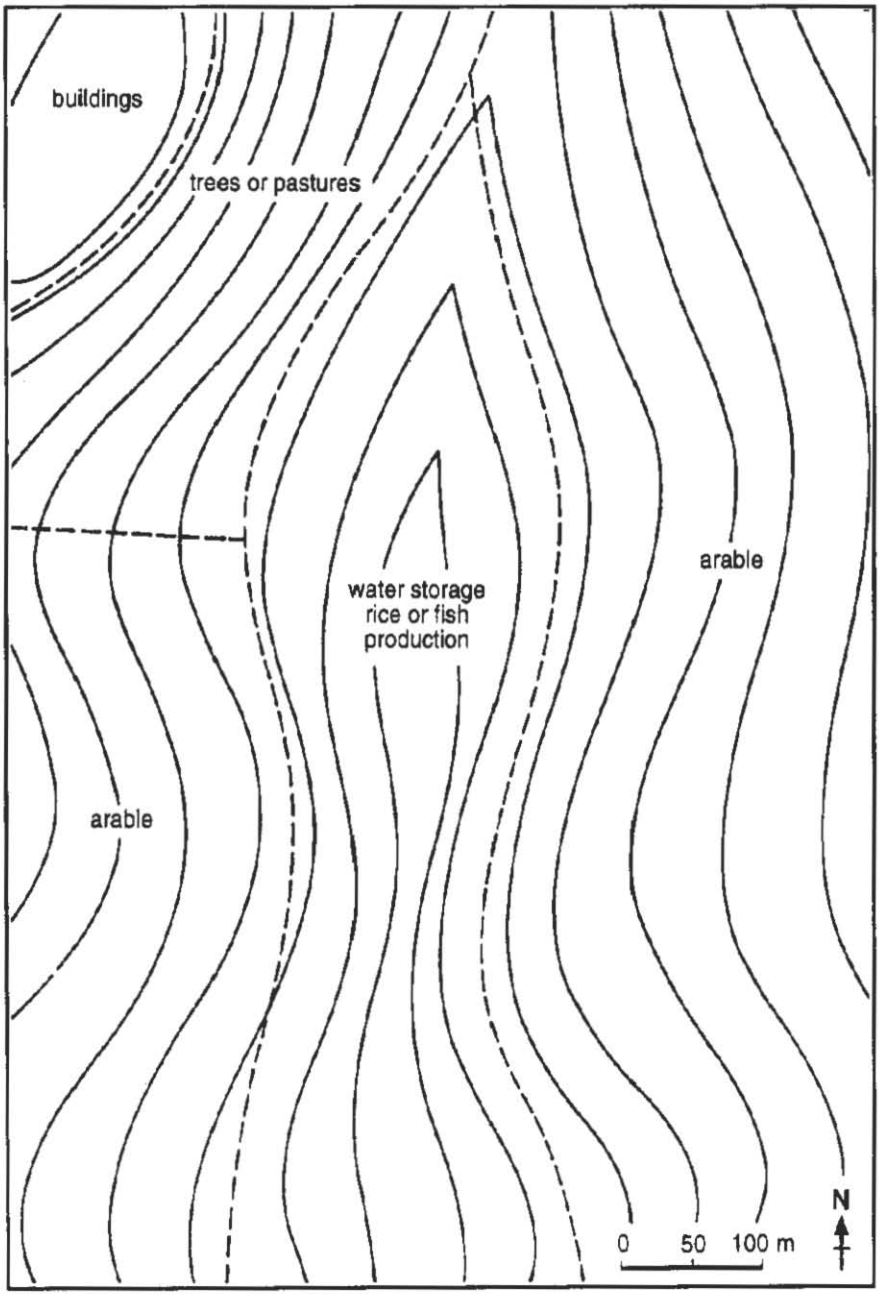
Map 1 Slopes and land form.
Map 2 Soil map.
Map 3 Land capability and usage.
Map 4 First development stage : water resources.
Map 5 Second development stage : buildings and roads.
Map 6 Third development stage : soil conservation measures.
Map 7 Final research station plan.



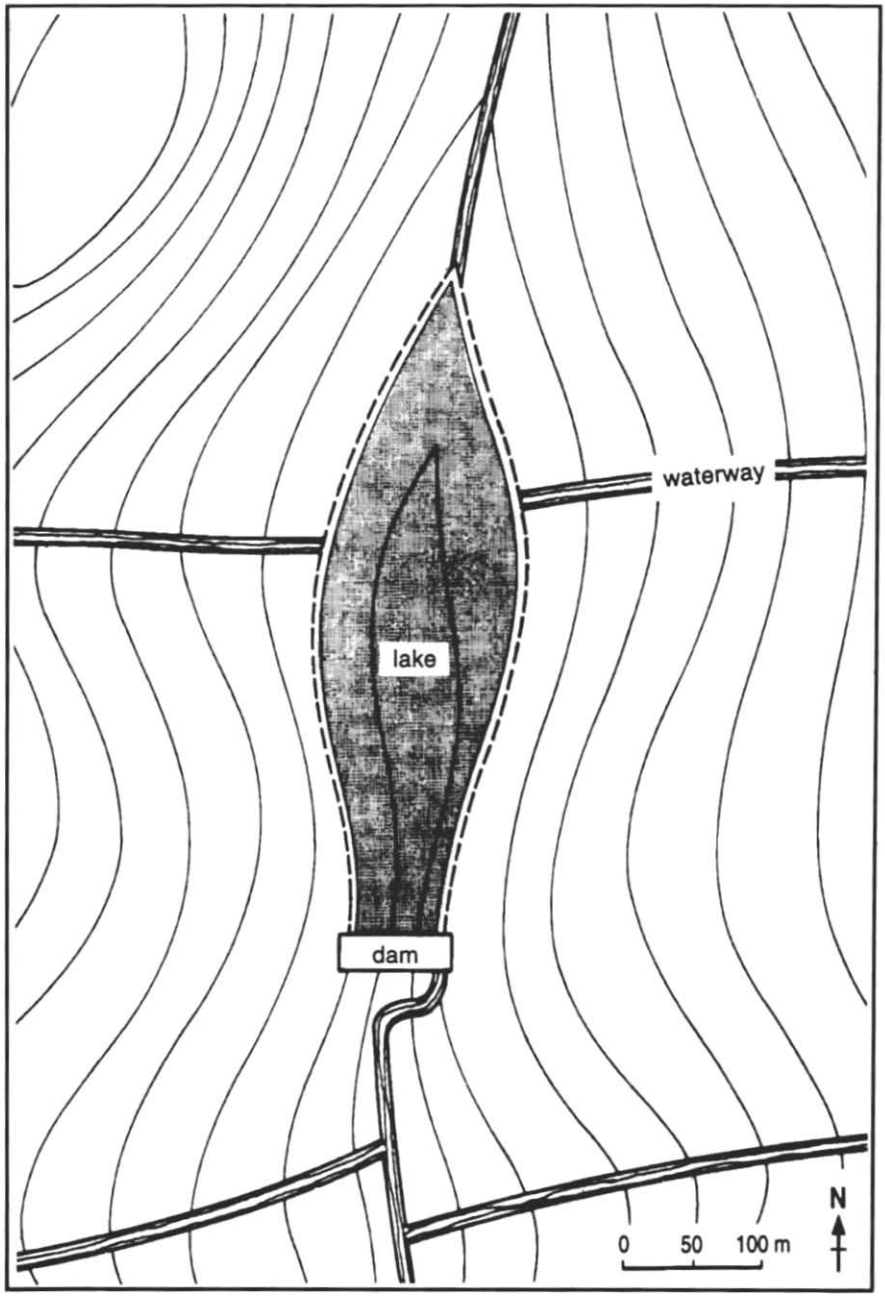
Map 1. Slopes and land form.



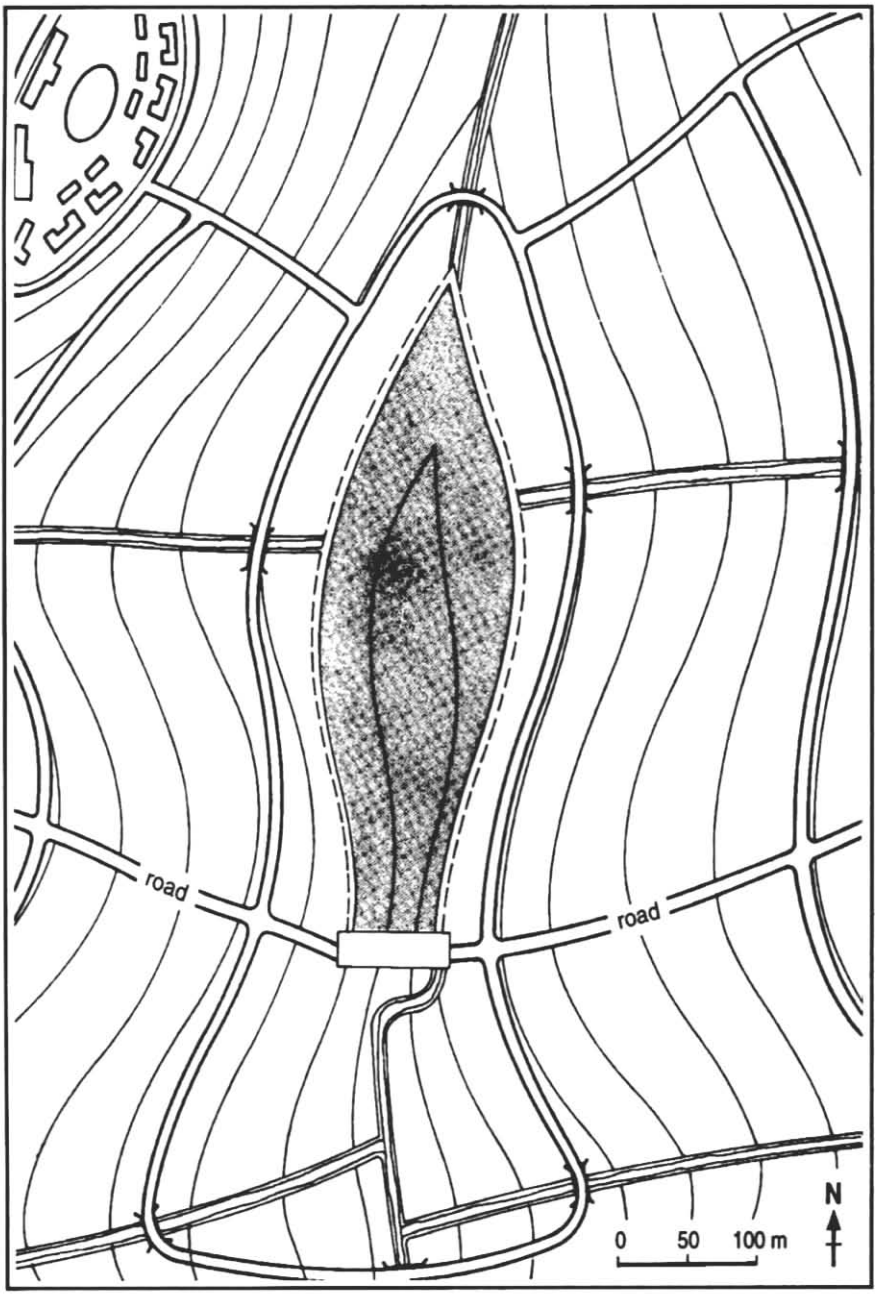
Map 2. Soil map.



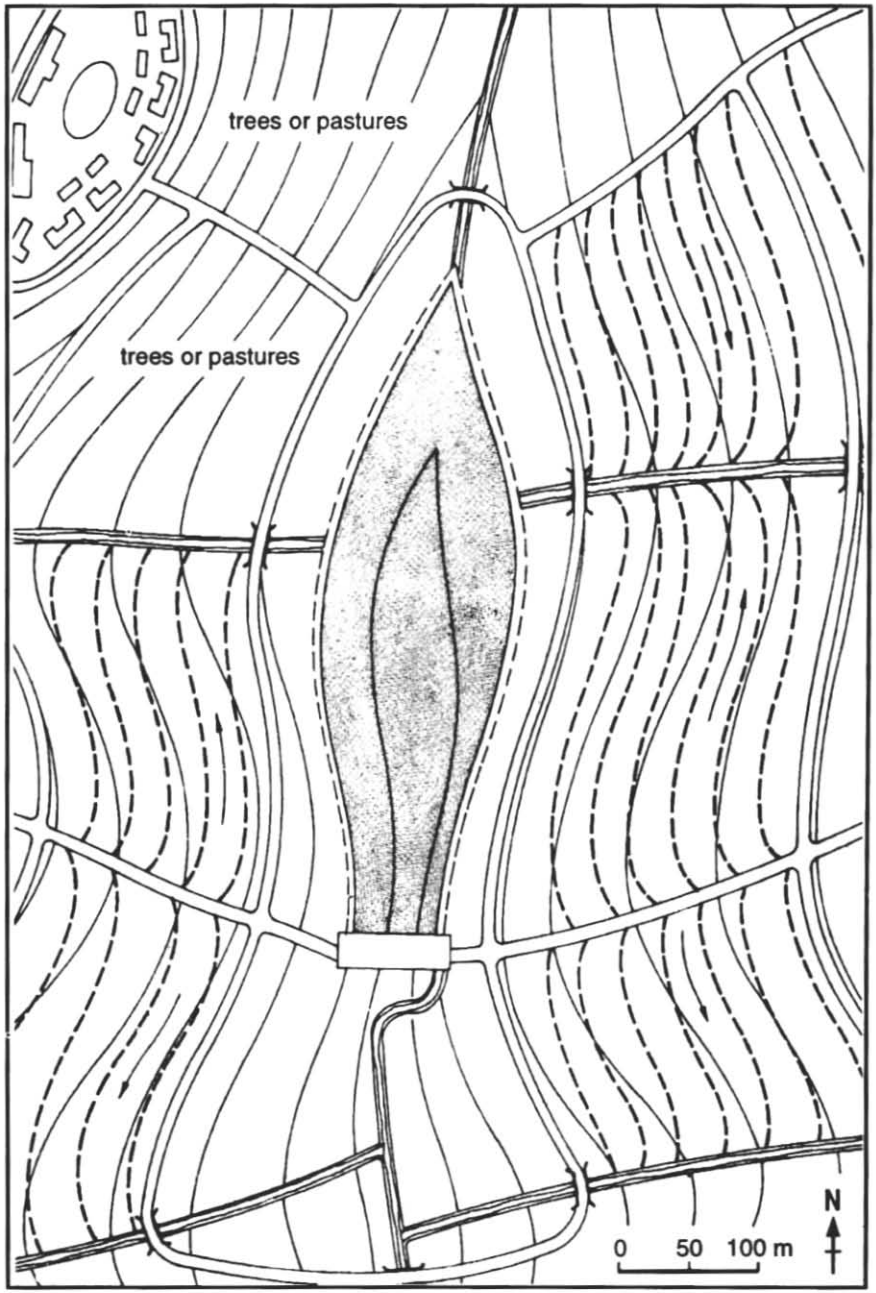
Map 3. Land capability and usage.



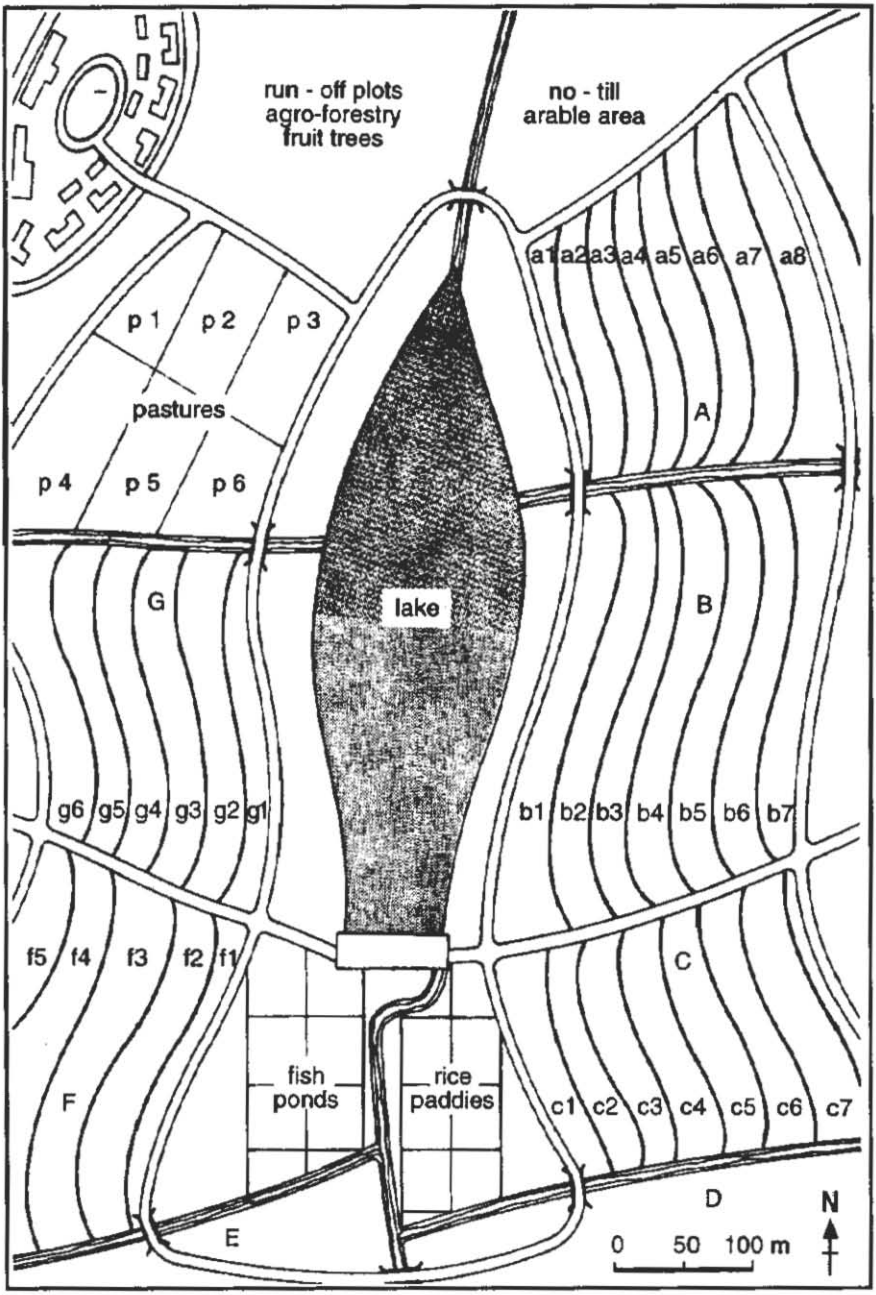
Map 4. First development stage: water resources.



Map 5. Second development stage: buildings and roads.



Map 6. Third development stage: soil conservation measures.



Map 7. Final research station plan.

6 Bibliography

Couper, D.C. 1995. Use of graded contour banks for soil conservation. IITA Research Guide 6. Training Program, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. 26 p.

Couper, D.C. 1996. Land survey for research stations. IITA Research Guide 1. Training Program, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. 38 p.

Pleysier, J.L. 1995. Soil sampling and sample preparation. IITA Research Guide 2. Training Program, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. 27 p.

7 Suggestions for trainers

If you use this Research Guide in training ...

Generally:

- Distribute handouts (including this Research Guide) to trainees one or several days before your presentation, or distribute them at the end of the presentation.

- Do not distribute handouts at the beginning of a presentation, otherwise trainees will read instead of listen to you.

- Ask trainees not to take notes, but to pay full attention to the training activity. Assure them that your handouts (and this Research Guide) contain all relevant information.

- Keep your training activities practical. Reduce theory to the minimum that is necessary to understand the practical exercises.

- Use the questions on page 4 (or a selection of questions) for examinations (quizzes, periodical tests, etc.). Allow consultation of handouts and books during examinations.

- Promote interaction of trainees. Allow questions, but do not deviate from the subject.

- Respect the time allotted.

Specifically:

- This document complements IITA Research Guides 1 and 6: "Land survey for research stations" and "Use of graded contour banks for soil conservation" (see Bibliography). You may treat these topics first.

- Discuss with trainees about experiences and problems of planning research farms (10 minutes).

- Present and discuss the content of this Research Guide, considering the study materials listed on page 3 (1 ½ hours). Ask trainees to help you calculate the examples.

  You may photocopy the illustrations of the Research Guide on transparencies for projection with an overhead projector (Maps 1 to 7).

- Conduct the practicals suggested on page 3 in groups (3-4 trainees per group; 2 hours). Give each group a topo-map and a soil map of another (your) research farm. Ask the groups to plan a research farm based on the maps (or to suggest improvements for your research farm). After a few days (evening work), ask the groups to present and discuss their results.

- Instead of **giving** maps to the groups, you may also ask trainees to **bring** maps of their own research farms for individual or group exercises.

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The International Institute of Tropical Agriculture (IITA) is an international agricultural research center in the Consultative Group on International Agricultural Research (CGIAR), which is an association of about 50 countries, international and regional organizations, and private foundations. IITA seeks to increase agricultural production in a sustainable way, in order to improve the nutritional status and well-being of people in tropical sub-Saharan Africa. To achieve this goal, IITA conducts research and training, provides information, collects and exchanges germplasm, and encourages transfer of technology, in partnership with African national agricultural research and development programs.

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